

District of Columbia Space Grant Consortium
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PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The District of Columbia Space Grant Consortium (DCSGC) is a Program Grant Consortium funded at a level of \$430,000 for fiscal year 2013.

PROGRAM GOALS

We proposed the following goals for FY 13-14:

Fellowship/Scholarship Programs

Our goal was to competitively provide scholarships and fellowships to meet the needs of NASA and DC, with an emphasis on women, minorities, and persons with disabilities. Our objectives were to competitively provide twenty scholarships to undergraduate and graduate students in STEM disciplines (including eleven to female students, seven to underrepresented minority students, and three to students with disabilities); to provide meaningful research opportunities to students; to increase the NASA/DCSGC presence in affiliate institutions; to facilitate student opportunities to work at NASA Centers; to provide mentoring for student researchers; to have twelve of these students become employed in a STEM field; and to have eight of these students pursue an advanced STEM degree.

Higher Education Programs

Our goal was to attract and retain students pursuing advanced STEM degrees and/or careers. Our objectives were to provide scholarships to undergraduate and graduate students; to arrange internships for six students; to provide robotics and ballooning activities for forty undergraduate deaf students in two revised STEM courses; to provide VLF training and a STEM career workshop at an HBCU for twenty-six underrepresented students and five faculty members; to provide a VLF training workshop for use in the

2014 International Space University; and to meet our target diversity participation level of 52% women and 37% underrepresented.

Research Infrastructure Programs

Our goal was to support students and faculty in STEM research opportunities at NASA Centers and universities. Our objectives were to support one faculty member (and three scholarship students) in on-campus mechanical and aerospace engineering research projects; to support three faculty members and one graduate student (and one scholarship student) in on-campus mechanical engineering research projects; to provide VLF research opportunities and training to four faculty members, ten undergraduate students, and two graduate students, and produce a VLF research journal and website; to support one faculty member to research and develop software for use in undergraduate STEM courses, analysis of NASA data, and support of NASA-sponsored websites, as well as conduct hands-on research at NASA GSFC's Laboratory for Terrestrial Physics with a NASA mentor and his team of scientists; to support one faculty member and one graduate student (and three scholarship students) in an on-campus energy-efficient communications protocol research project; to support two faculty members (and two scholarship students) in on-campus STEM research projects; and to meet our target diversity participation level of 52% women and 37% underrepresented.

Precollege Programs

Our goal was to inspire K-12 students to pursue STEM disciplines and careers by supporting K-12 teacher training workshops and activities. Our objectives were to support one teacher (with eight students) in a robotics and engineering Botball precollege course and tournament; to send eight teachers (with eight students) from a school for the deaf and schools with high student minority populations for hands-on training at NASA Space Camp; to train fifty teachers (and 1,500 students) to utilize an internet-based Space Explorers program that utilizes NASA data, research, and themes; to provide long-duration training to nine teachers; to provide short-duration training to fifty teachers; and to have thirty-six out of the fifty-nine teachers utilize the long-duration and short-duration training in their classrooms.

Informal Education Programs

Our goal was to inform and inspire DC citizens about NASA and DCSGC opportunities. Our objectives were to hold seven Family Science Nights at the Smithsonian Air & Space Museum and reach 2,450 members of DC's diverse population, and to train student explainers to give tours of the Voyage Scale Model Solar System on the National Mall and reach 4,500 members of DC's diverse population.

PROGRAM/PROJECT BENEFIT TO OUTCOME (1,2, & 3)

The following anecdotes highlight just a few of the projects we supported so far in FY 13-14:

Outcome 1

Hannah Clark, a minority computer science major from Howard University, landed the opportunity of a lifetime as a result of participating in three of our activities over the past

several years. When she was in middle school, Hannah attended a workshop we co-sponsored for female students in the DC Public Schools promoting STEM careers for young women. As a result of our workshop, she became the first recipient of our affiliate's Space Camp Scholarship for Students. She was so inspired by Space Camp that she decided to pursue a career in space science, and has mentored other middle and high school students. Upon enrollment at Howard University, Hannah also received our William Taylor Memorial Scholarship Award. The Award allowed her to focus on her academics instead of getting a job she otherwise would have needed, and it paid off when Hannah received the news that she was one of only 1,500 students from an applicant pool of more than 40,000 to receive a paid Google Engineering Practicum Internship in Mountain View, CA this summer. The twelve week program will provide Hannah with hands-on experience via a software project, skills-based training, and professional development. Hannah directly credits landing this unique opportunity with her participation in our programs. Hannah epitomizes the DC Space Grant Consortium STEM pipeline!

We launched a new Minority Faculty-Student Research competition. Jandro Abot from Catholic University was one of our minority faculty award recipients. Although he was only required to mentor one student on the research project, he decided to mentor three students, two of whom are female: Tareq Alosch, Angeline Bajar, and Erica Good. The students' research led to the unveiling of the electromechanical response of carbon nanotube yarns under tension – a new discovery with important implications for many engineering applications. The discovery resulted in the publication of the findings in the research journal Carbon, and in Dr. Abot being named a Fulbright Scholar and receiving a \$30,000 Fulbright Award. It also encouraged Angeline to pursue her graduate studies and continue the research. The two female students presented the research findings at the Society of Hispanic Professional Engineers' Engineering Research Conference in Indianapolis, Indiana in 2013. Tareq recently completed his Master's Thesis around the project. An article highlighting the students' work is presented on Catholic University's website at: <http://mechanical.cua.edu/sidebarlinks/cntyarn.cfm>.

In the past year, our faculty and student research team at George Washington University have applied for one patent, published nine articles, made nine presentations, and been awarded an additional \$341,400 from NASA and the National Science Foundation from an additional five proposals, as a result of our ongoing support of their research on micropropulsion. In addition, both NASA ARC and NASA GSFC are extremely interested in their research, and requested additional proposals from them so that they can develop the concept further for flight. One of our students, George Teel, was invited to NASA ARC for a Summer 2014 internship due to his involvement on this project. Our other student, Joseph Lukas, recently was awarded two fellowships to complete his PhD research on this project. Due to our faculty member's involvement on this project, in October 2013, he hosted the 33rd International Electric Propulsion Conference, which boasted a record attendance despite being held during the government shutdown. The DCSGC was asked to be a co-sponsor of the conference, and although we were unable to co-sponsor the conference due to a lack of augmentation funding, we still supported and attended the conference. The official press release for the conference can be found at:

<http://mediarelations.gwu.edu/george-washington-university-hosts-record-size-international-electric-propulsion-conference>.

PROGRAM ACCOMPLISHMENTS

We made the following advancements so far towards our FY 13-14 goals:

Fellowship/Scholarship Programs

Fifteen scholarships have been awarded so far. Ten scholarships were awarded to undergraduate students and five scholarships were awarded to graduate students. The scholarship recipients attend American University (AU), Catholic University of America (CUA), Gallaudet University (GU), George Washington University (GWU), Howard University (HU), and Tarleton State University (at GU for a summer research experience). Eight scholarships (53%) were awarded to females, five (33%) to underrepresented students, and three (20%) to students with disabilities. All fifteen scholarship recipients were matched with NASA mentors and university faculty mentors on various NASA Center internships and on-campus university research projects. It is too early to tell what percentage of this year's students will be retained and graduated in STEM disciplines or what percentage will seek or attain STEM employment, but the students have been added to the DCSGC longitudinal tracking database for annual follow-up.

Higher Education Programs

We supported the revision of an undergraduate physics lab course, the revision of an undergraduate physics course in science fiction and physics, and the creation of a new undergraduate physics course in global climate change at GU. The revised physics lab course included construction of an underwater remotely operated vehicle (ROV) as a semester-long student project. The revised physics course in science fiction and physics was entitled "Scientific and Quantitative Reasoning in Context: Science Fiction Philosophysics." The new physics course was entitled "Communicating Earth Science: Knowns, Unknowns and Controversies." Two faculty members and thirty-two deaf students participated in the new and revised courses at GU. We supported a planning committee that is developing two INSPIRE Workshops to be held in 2014 on the topic of "Teaching Science with an Enthusiastic Attitude." The workshops include VLF research and training for attendees and STEM career guidance. One will be hosted at HU (an HBCU), and the other will be hosted in connection with the International Space University. We supported scholarships and summer internships for eight students at our nearest NASA Center, NASA Goddard Space Flight Center (GSFC). The eight students were paired with NASA mentors for research activities.

Research Infrastructure Programs

We supported a faculty member from GU to research and develop software for use in undergraduate STEM courses, analysis of NASA data, and support of NASA-sponsored websites, and conduct hands-on research at NASA GSFC's Laboratory for Terrestrial Physics (Science Mission Directorate) with a NASA mentor and his team of scientists. The work included remote sensing data processing and updates to the NASA-sponsored website www.oceanmotion.org. We supported a team of one faculty member and two

scholarship students at GWU in an aeronautics research project on micro thruster technology for small satellites, which resulted in two invited research papers being presented at a scientific conference, seven self-submitted papers being presented, nine articles that have been published or are pending publication, and one patent application. As a direct result of this research an additional five proposals were submitted, which have garnered an additional \$341,400 in funding from NASA and the National Science Foundation (NSF). Another result of this research is that the faculty member was selected to host the 33rd International Electric Propulsion Conference in October 2013, with a record attendance of 400 faculty and student researchers delivering more than 356 papers. We supported the publication of a VLF research journal and website, which included scientific articles and content from some DCSGC interns and program participants including one faculty member, four undergraduate students, and one post-doctoral student. We supported one female faculty member and one male faculty member with one male student on a summer research project at the HU Observatory, and one male faculty member with one female student and one male student on a summer research project in physics at AU. The first project focused on restoring the observing facilities at HU during summer 2013, and was carried out as a first step in a partnership between AU and HU for the purpose of teaching astronomy to undergraduates at both universities with these updated facilities, and holding public observing sessions to promote STEM education to the DC public. As a result, our HU collaborators submitted a proposal to NSF and were awarded an additional \$330,798 for ongoing HU Observatory activities. The second project focused on cutting-edge summer research experience in ultracold atomic dynamics. The two students supported in the second project worked with their faculty mentor during summer 2013 on a research project simulating how three-body interactions can affect the dynamics of ultracold atomic gases. In addition, the students participated in formal and informal activities that encouraged and enabled them to pursue a profession in a NASA-supported field of STEM research. The results from the summer work have been collected into two papers. The faculty member presented results at two conferences, one student presented a poster at the March 2014 APS meeting, and the other student is continuing the research project with the faculty mentor for her senior capstone project. We supported two minority faculty-student research teams. For the minority faculty research project at CUA, the research objective of the project was to investigate the change in impedance as a function of mechanical strain in carbon nanotube yarns. The project included the preparation of samples and their coupled mechanical and electrical characterization under tension loading. The collected experimental data and obtained information about the physical mechanisms constituted another step towards the development of integrated carbon nanotube yarn sensors to monitor strain and damage in composite and polymeric materials. For the minority faculty research project at UDC, the research objective of the project was to investigate and design ways in which NASA could deploy multiple robots or rovers instead of a single robot or rover in its missions. The research studied ways that future missions could use a more distributed approach to rover architecture design. Deploying multiple robots instead of a single rover can increase robustness and fault tolerance. While single-robot systems are spatially limited, multiple rovers are able to spread out and work in parallel. Also, multiple robots can be useful in tasks that require considerable amount of resources and capabilities that may be too complex for a single

robot. As robots work together, communication can speed up completion, reduce duplication, and prevent interference between robots.

Precollege Programs

We supported two high school science teachers at the Model Secondary School for the Deaf (MSSD) to incorporate robotics, Botball, and Space Camp activities into their classrooms. Two teachers and five students from MSSD participated in the 2014 Botball and Deaf Space Camp activities. As a result, the Botball mentor at MSSD has gotten approval to teach a robotics course in Fall 2014, and the Space Camp mentor attended Deaf Space Camp (a program that partners with NASA Marshall Space Flight Center (MSFC)) with four deaf students in Huntsville, AL where she underwent 45 hours of intensive classroom, laboratory, and training time. The program focuses on space science and exploration with astronaut-style training and simulations. It also provides lessons for teachers to take back to their classrooms that are directly related to STEM activities. We supported 27 teachers at Stuart Hobson Middle School in mentoring 1,100 6th-8th grade students for the SSEP Mission 3 to the International Space Station (ISS). One experiment and 2 patches were competitively selected for the launch to the ISS in early 2014. All 29 of the teachers we supported incorporated NASA resources into their classrooms.

Informal Education Programs

We supported a Family Science Night series at the Smithsonian National Air & Space Museum. Attendees explored the museum's galleries after hours, experienced an IMAX film, and heard a presentation by a dynamic space scientist. Four evening events were held reaching 1,327 students, parents, and teachers. We supported Science Research Day at AU in January 2014 that reached approximately 124 students, faculty, administrators, and staff. The event was designed to bring awareness to students of the vast array of STEM research opportunities at AU. We were invited to attend and reach out to students about our opportunities. We supported an upgrade to the content storyboards for the Voyage Scale Model Solar System on the National Mall. These educational storyboards are seen by the millions of people who visit the National Mall each year, and the DCSGC logo is featured prominently – one of only three logos featured – next to the Smithsonian logo and the National Center for Earth and Space Science Education logo on the entry panel next to the Smithsonian National Air & Space Museum. They were installed and unveiled on the National Mall in July 2013.

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Student Data and Longitudinal Tracking:** All of the students we support with direct scholarship funding or who participate in higher education or research infrastructure programs for 160 hours or more are in the DCSGC longitudinal tracking database and are monitored for progress through an annual survey. Since 2006, we have supported 171 students in the fellowship/scholarship category, 20

students in the higher education category, and 3 students in the research infrastructure category (including current year awardees). Of the total 194 students we are tracking, 88 (45%) of the students were underrepresented minority students and 27 (14%) of the students had disabilities. 95 (49%) of the students were female. 40 (21%) of the students are still enrolled in their current degree program, 40 (21%) have graduated and are pursuing advanced STEM degrees, 28 (14%) have graduated and are seeking STEM employment, 5 (3%) are employed in STEM as aerospace contractors, 58 (29%) are employed in STEM in non-aerospace positions, 3 (2%) are employed by NASA, 2 (1%) are employed in a STEM K-12 field, 8 (4%) are employed in a STEM higher education academic field, and 10 (5%) are employed in a non-STEM field.

- **Minority-Serving Institution Collaborations:** We supported scholarships and programs at two HBCUs (HU and UDC) and one university for the deaf (GU). We supported scholarship programs such as GU Scholarship Program, HU Scholarship Program, UDC Scholarship Program, and NASA Summer Internship Program for students at GU, HU, and UDC which resulted in on-campus and NASA Center internships for underrepresented students. We supported higher education programs such as GU Robotics Activities Program which includes new course development. We supported research programs such as GU Faculty Research Program in remote sensing imagery analysis, Minority Faculty Research Program at CUA and UDC which resulted in robotics and carbon nanotube yarn sensor research activities with minority faculty-student teams, and AU Faculty Summer Research Program at AU which resulted in a collaboration with HU to restore HU's observing facilities and was carried out as a first step in a partnership between AU and HU for the purpose of teaching astronomy to undergraduates at both universities with these updated facilities and holding public observing sessions to promote STEM education to the DC public. We supported precollege programs such as Botball, Space Camp for Educators, Space Explorers, and SSEP in the DCPS, which are predominantly African-American. We are carrying over a research program at UDC because the faculty member who was to carry it out left the university, and have begun working with a new faculty member, so it will be reported on next year. We are in the process of supporting a minority faculty-student team from HU for the RockOn! Workshop at NASA Wallops Island, where they will develop science payloads for suborbital rocket launches, to be reported on next year.
- **NASA Education Priorities:**
We made the following accomplishments so far to support NASA's Current Areas of Emphasis:

 - **Authentic, hands on student experiences:** Our scholarships, higher education, and research programs incorporated internships, robotics, and other hands-on research projects at the university level. Our precollege programs, though focused on teacher training, incorporate hands-on student participation at the precollege level as an added benefit.
 - **Diversity:** The institutions, faculty, and students involved in our scholarship, research, higher education, precollege, and informal education programs were

diverse. Our affiliates include two HBCUs and one OMI. 33% of our scholarship recipients were underrepresented minorities. The DC Public Schools are predominantly African-American.

- **Engage middle school teachers:** All of our precollege programs involve engaging middle school teachers in hands-on curriculum enhancement opportunities for them to incorporate into their classrooms and expose their students to NASA resources. Our informal education programs include Family Science Nights that involve the participation of middle school teachers.
- **Summer opportunities for secondary students:** Our scholarships, higher education, and research programs included summer internship programs on college campuses.
- **Community Colleges:** There are no community colleges in the District of Columbia.
- **Aeronautics research:** Our scholarships, higher education, and research programs included NASA internships and on-campus research projects that incorporated aeronautics research.
- **Environmental science and Global Climate Change:** We supported a hands-on research experience for a faculty member at NASA GSFC's Laboratory for Terrestrial Physics that included analysis of data on earth's environments. We created a new undergraduate physics course in global climate change at GU entitled "Communicating Earth Science: Knowns, Unknowns and Controversies."
- **Enhanced capacity:** Our research programs included support of faculty in research geared towards NASA priorities in the Science Mission Directorate.

IMPROVEMENTS MADE IN THE PAST YEAR

We made several improvements and adjustments over the past year. In addition to generally streamlining the logistics of some of our management and ongoing activities, we have seen an increase in applications and proposals as our profile increases at the lead and affiliate universities and as we increase advertising of our opportunities through venues such as FaceBook; we circulated our Strategic Plan for input from all affiliate members; we created new consortium-wide program reporting forms; we have begun designating some of our costs that previously were categorized as administrative under the appropriate activity categories in OEPM so that our budget more accurately reflects our Outcomes 1-3 project support; we received an augmentation award which has led to new partnerships and the launch of several new programs; we began working with new affiliate representatives at HU and UDC; and we are implementing new site visits to affiliates throughout the year.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

In addition to working with various organizations on particular aspects of certain programs, the following seventeen institutions are DCSGC members, affiliates, and partners that regularly participate in activities:

- American University (Lead Institution): private university – supports scholarship, research, higher education, precollege, and informal education programs, as well as managing the consortium
- Aries Scientific: nonprofit – supports higher education and precollege programs
- Catholic University of America: private university – supports scholarship and research programs
- Gallaudet University: minority institution/federally chartered/quasi-governmental university for the deaf and hard of hearing – supports scholarship, precollege, research, and higher education programs
- Georgetown University: private university – supports scholarship and research programs
- George Washington University: private university – supports scholarship and research programs
- Howard University: HBCU/private university – supports scholarship, higher education, and research programs
- NASA Goddard Space Flight Center: government – supports scholarship and higher education programs
- NASA Headquarters: government – supports scholarship and higher education programs
- National Center for Earth and Space Science Education: science center – supports precollege and informal education programs
- National Space Grant Foundation: nonprofit – supports scholarship and higher education programs
- S.M.A.R.T., Inc.: nonprofit – supports precollege, higher education, and informal education programs
- Smithsonian National Air & Space Museum: government – supports higher education, precollege, and informal education programs
- Space Explorers, Inc.: nonprofit – supports precollege programs
- The INSPIRE Project, Inc.: nonprofit – supports scholarship, research, higher education, and precollege programs
- Trinity Washington University: minority institution/private university for women – supports scholarship programs
- University of the District of Columbia: HBCU/public university – supports scholarship, higher education, and research programs

The National Space Grant Office requires two annual reports, the Annual Performance Data Report (APD) and the Office of Education Performance Measurement System (OEPM) report. The former is primarily narrative and the latter data intensive. Because the reporting timeline cycles are different, data in the two reports may not necessarily agree at the time of report submission. OEPM data are used for official reporting.